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THE
MORRIS ARBORETUM
OF THE
UNIVERSITY OF PENNSYLVANIA

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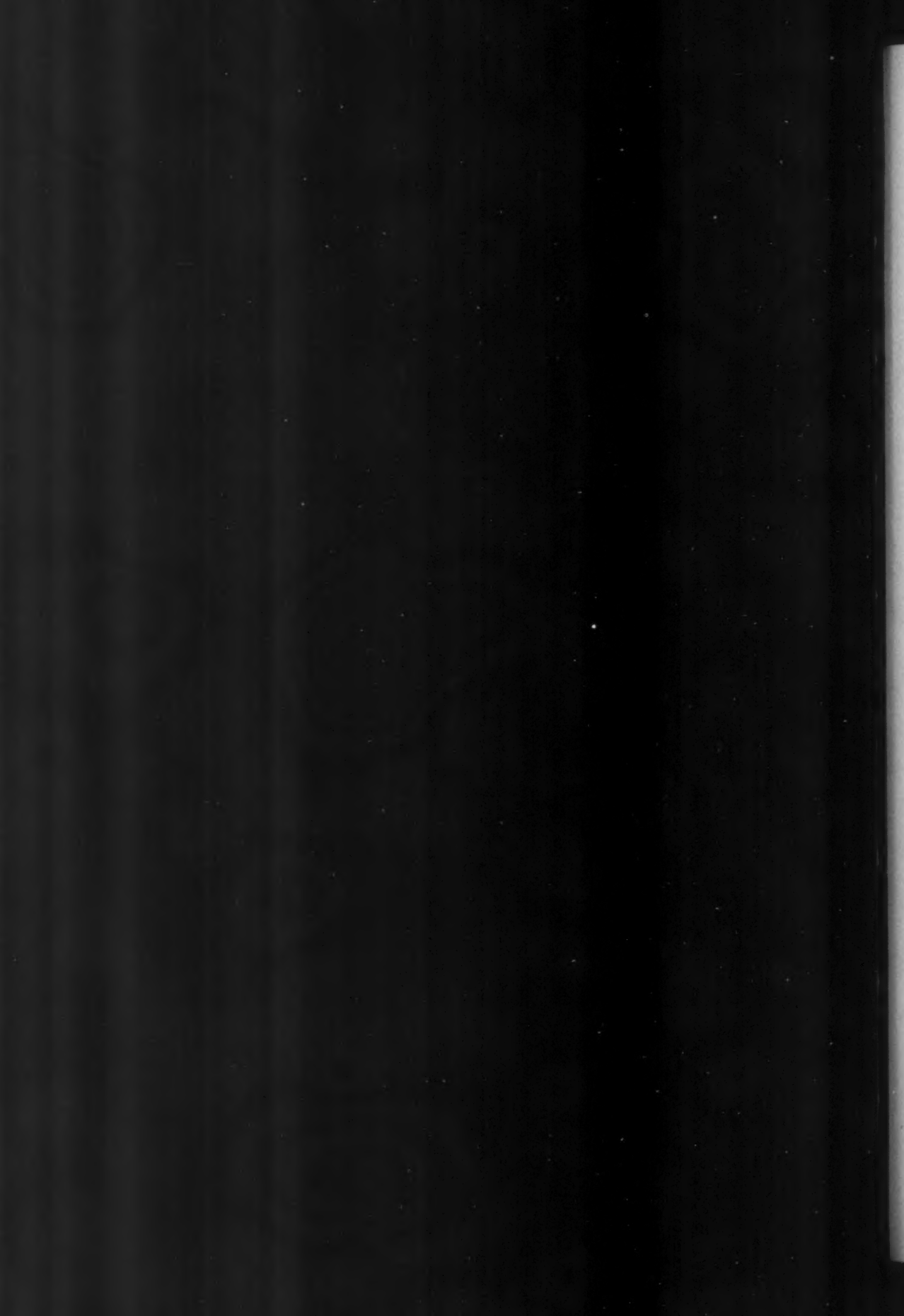
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THE
MORRIS ARBORETUM
OF THE
UNIVERSITY OF PENNSYLVANIA



Rhododendron speciosum always excites
comment on its conspicuously handsome flowers

(See page 42)

GROW MORE NATIVES *

WE ARE indeed fortunate. Nature has endowed our country with a most magnificent native flora. But does the average American gardener appreciate this dower? Alas, a thousand times to one the answer is no.

On the other hand, the British gardener is vastly interested in our floral treasures, and annually spends large sums in acquiring such shrubs and plants as are available. This is especially commendable when one considers that theirs is a cooler climate than ours and American plants require a hotter sun than they can offer. As a rule, our plants do not thrive as well in Great Britain as do those from the Asiatic mountains, from whence such splendid plants have come in recent years. On more than one occasion, I have heard complaints from distinguished British gardeners that it was easier to obtain plants from Asia, or almost anywhere else, than from America! They are well posted and know we have all sorts of wonderful shrubs and plants that are still unknown in cultivation, but "How," they say in despair, "can they be obtained?" The average American nurseryman carries out-of-date plant material and there is mighty little variety in the stock. American gardens are greatly the poorer because of this. Travelling through the country, one marvels at the tiresome similarity of the flowers and shrubbery of most gardens.

For many years, in an earnest endeavor to help correct this situation, it has been my privilege to tramp over various sections of the Atlantic Coastal Plain of the Southland, in search of rare and beautiful native trees, shrubs and plants. Frequently I have wandered for miles along little known rivers. Then sometimes I am lured to flounder in lonely swamps often with water and mud seeping over the tops of my hip boots. The plants have always proved to be more than worth the effort. Hills and mountains too of other geologic provinces have been searched on some thirty plant collecting trips to the Southeastern States. The results of these journeys have far exceeded my fondest anticipations and my most ambitious dreams, for the beauty and variety of some of our little known native plants defy description. It is most gratifying that these shrubs and plants have made themselves thoroughly at home at Gladwyne. They require almost no care when once established in a congenial spot. They thrive in our hot summers, and our wet and

* *Editor's Note.*—The Morris Arboretum feels fortunate in being able to present this article by Mrs. J. Norman Henry, to be concluded in the next issue of the Bulletin.

As a field botanist with a very personal knowledge of American plants native to numerous special areas of our country, no less than as a real horticulturist, Mrs. Henry's name has become widely known and respected.

Photographs illustrating this article are by Josephine de N. Henry.

changeable winters have no terrors for them at all. Providing we are wise in our selection of plants, the soil we have to offer is usually satisfactory with little or no fixing or fussing. There is no doubt that the average American plant is a better grower and a longer-lived inhabitant of our gardens than the average foreigner.

The day must come, and let us hope it will be soon, when gardens will not be tolerated which contain shrubs and plants "dolled up" in dismal shrouds and bur-laps during the winters. Such doleful objects make our gardens sorry sights, whereas they should contain some beauty in winter as well as summer. We can never have showy winter flowers in our climate, but we *can* have beauty and variety in ever-green foliage and the attractive winter rosettes of many herbaceous plants. There is lively color, too, in the stems and barks of certain trees and shrubs. These latter are conspicuously beautiful when snow is on the ground.

Our foremost duty, if we grow native trees, shrubs and plants, is to grow them from seeds, instead of robbing the wild. If we purchase "collected" plants, we pay someone else to do our robbing for us. If we must buy plants we should see to it that the nurseryman propagates them from seed, cuttings or divisions. Even trees and shrubs are easily raised by this method. In these days vast operations are accomplished by the unskilled labor of the CCC's, and in the south, the prison gangs' irreparable harm to our native vegetation is often accomplished in an incredibly short space of time. Lakes and swamps are often filled to the level or, what is just as bad, sometimes they are drained. Either of these operations on the countryside will destroy the natural vegetation surrounding them. It is in just such places that so many of our most precious treasures make their abode. Among these latter are lilies and orchids. Then, too, the repeated burnings of underbrush in woodlands, in many instances, has completely wiped out whole stands of choice varieties of native azaleas, and so the deplorable story goes on.

Seedling azaleas will often bloom when less than three years of age. The collecting of seeds of our native azaleas is of far greater importance than collecting the plants. There are numerous varieties of the different species and many of these varieties possess very definite horticultural value. It is especially necessary to perpetuate these varieties before they are totally destroyed.

The glorious Halesias (Silver Bell Trees) are among the grandest and most ornamental trees of the American forests. Eighty- and ninety-foot specimens of *Halesia monticola* on the Carolina mountainsides in full bloom, with their snow white bells all strung along their branches, form a sight not easily forgotten. Fortunately for us gardeners, this grand tree is easily raised from seed and blooms

when very young. I found a beautiful pink-flowered variety (see Fig. 1), also another distinctive one with blossoms colored a "café au lait." *H. parviflora* is a pleasing shrub. *Styrax grandifolia*, a small tree and a relative, is an important beauty. Its white flowers are as sweetly scented as orange blossoms. Although not so hardy as *Halesia*, it succeeds here. The little shrubby *S. americana* is a gem of the highest class. It bears its deliciously fragrant white blossoms abundantly.

Malus angustifolia is one of our most beautiful crabapples, yet it is scarce in our gardens. *Crataegus apiifolia* has leaves of exquisite grace and laciness. When covered with its mantle of white flowers it is more than passing fair. The little *C. uniflora* is a delightful small shrub, with comparatively large white flowers that are borne singly. It comes quickly from seed.

Stewartia pentagyna, *S. malachodendron* and *Franklinia alatamaha* are beautiful small trees belonging to the tea family and bearing large white flowers like camellias.

Aesculus octandra is an attractive tree with yellow flowers.

However, when all is said, I rather think if I had room for but one small tree, it would be *Magnolia virginiana*, our superlatively lovely native magnolia.

Among shrubs *Cyrilla racemiflora* is unusual and beautiful and bears exceptionally handsome foliage as well as pretty white flowers.

Hamamelis macrophylla blooms several weeks after *H. virginiana* and is therefore probably our latest flowering shrub. *H. vernalis* (Fig. 2) is a fragrant winter flowering witchhazel and its flowers are warmly welcomed on a mild January day. In addition to yellow-flowered forms there are several attractive red-flowered plants at Gladwyne.

Viburnum alnifolium is perhaps our finest native species and it can hold its own with the best of the foreigners.

An enchanting *Calycanthus* from Georgia is a dwarf grower and bears pink flowers.

There are many magnificent hollies that are well worth growing, among them *Ilex verticillata padifolia*, *I. laevigata*, *I. monticola* and *I. coriacea*. The yellow-fruited form of *I. verticillata* is most attractive, so is the yellow-fruited *I. opaca*.

Salix tristis, in spite of its name, is a sweet and dainty willow whose little branches are covered with tiny gray silky "kittens" each spring. Its full height is only about 24 inches.

Anyone fond of miniatures would enjoy *Quercus pumila*, a tiny oak that often produces its pretty reddish catkins and little acorns when but 12 or 18 inches high!

Had I room for but six shrubs, *Zenobia pulverulenta* would surely be among them. The perfection of its chaste and exquisite white bells would be difficult indeed to improve upon. It does best with some shade.



FIG. 1.



FIG. 2.

FIG. 1. *Halesia monticola*. This pink flowered variety is a very striking beauty.—FIG. 2. *Hamamelis vernalis*. The deep red flowered variety is beautiful against the snow in January.

Lyonia lucida, a relative, is another beauty, especially the form with crimson buds that open to bright pink flowers. This one does best in full sun.

Elliottia racemosa, a rare and illusive beauty native to Georgia, has been growing here for years. It seems perfectly hardy and it produces its flowers regularly each season.

The white fruited variety of *Vaccinium nitidum* is indeed an enchanting little shrub, hardy as the proverbial "rock" and always excites great interest.

The deciduous Rhododendrons, or Azaleas, as they are still called by many, have been left to nearly the end of this very brief list of shrubs. The reason for this is simply that it is quite impossible to give any but the very slightest idea of their extraordinary variety and great beauty in any abbreviated account.

Many trips have been taken by the writer with this group of shrubs as the objective. Seeds, suckers and divisions have been brought home from most of my trips to the southeastern states. *Rhododendron cumberlandense*, recently described in "Rhodora" as a new species, is undoubtedly one of the most magnificent of all American shrubs. Words cannot do justice to the amazing rich red tones of its blossoms. I collected this one in 1936. Specimens of *R. speciosum* (see frontispiece) from various localities are growing here. Contrary to the usual descriptions of this species, the flowers are frequently of orange shades. The most attractive colors, however, are the clear vivid reds. When these are in bloom scarcely a stem or leaf is visible from base to top of plant. *R. austrinum* (Fig. 3) always makes another spot of marvelous color in the wild garden. Fragrance is an



FIG. 3. *Rhododendron austrinum* has been growing at Gladwyne for many years.



FIG. 4. *Halesia monticola* at the Morris Arboretum. This is an especially large flowered form and is now 32 feet high.

added charm, the only one in this orange colored group to possess it. *R. canescens candidum* is an absolute "must have" for everyone who sees it. It is a magnificent azalea and very floriferous, producing large showy clusters of white and delightfully perfumed flowers. Other rare and beautiful native species are here, too.

Only one evergreen Rhododendron will be mentioned in this little sketch, but it is a gem "of the first water," namely *R. Chapmanii*. It is a medium-sized shrub with comparatively small flowers of an exquisite shade of pure pink, with no tinge of magenta. Sometimes pale pink but often in deeper shades and always fine, *R. Chapmanii* has been growing here for over six years.

None of these plants receives protection of any kind whatsoever after it becomes established in its new home and the foregoing shrubs have withstood the rigors of the recent cold winters.

These rare and amazingly beautiful shrubs should be gracing our gardens more frequently. They are almost our next-door neighbors. Let us welcome them as such to our gardens.

(To be continued)

—Mary G. Henry

Gladwyne, Penna.

ONE HUNDRED THOUSAND BELLS

YES, THIS is the approximate number of nodding white "bells" carried this year at the Arboretum by the largest specimen of *Halesia monticola* (Fig. 4), the Silverbell or Snowdrop Tree—a magnificent sight provided by this plant which ranks among the handsomest of all our flowering trees.

In view of the great decorative value of the Silverbells it is difficult to understand why they have not been more widely planted, unless merely perhaps because they are American natives which, like so many others of their kind, have been sadly overlooked. There are probably more in cultivation in the Philadelphia region than elsewhere in the country, but in spite of this there are far from enough.

The genus *Halesia* was named in honor of Dr. Stephen Hales, the English author of a celebrated work on "Vegetable Staticks," who lived from 1677 to 1761. It belongs to the family *Styracaceae* and is related to another bell-flowered tree of our gardens—the dainty Storax or *Styrax*. Four species of Silverbell are all

native to the Eastern United States. *Halesia carolina* is a very showy plant of more or less bush habit, which reaches a height of about 30 feet in the lower lands of West Virginia to Florida, Texas and southern Illinois; *H. monticola* is native to forests of the higher mountain slopes where it not uncommonly attains a height of 80 or 90 feet. Apart from this difference of habit and the slightly greater flower size of *H. monticola*, it is very difficult to distinguish from the foregoing species, particularly under cultivation; *H. diptera* as seen in gardens is usually characterized by fairly low and bushy growth, and later May flowering than either of the foregoing species. The fruits carry two rather than the four prominent wings of *H. carolina* and *monticola*. It is not quite so hardy in the north and seldom carries as generous a flower display. The fourth species, *H. parviflora*, also from the Southern States, is of shrub habit, with rather small flowers, and extremely rare in cultivation. It is evidently not very hardy in the north.

Some half-dozen forms or varieties of the Carolina and Mountain Silverbells have been recognized, but with one or two exceptions they are of botanical rather than horticultural interest. *Halesia carolina* var. *dialypetala* is distinguished by the deep division of its petals almost to the base; var. *mollis* has extra broad and pubescent leaves. Var. *Meehani* is a very distinct low-growing form with abundant small flowers and wrinkled leaves, which originated as a seedling from *H. carolina* in Meehan's Nursery in Germantown, Philadelphia, somewhere around 1880. It is now seldom seen in cultivation. Of the Mountain Silverbell, var. *vestita* is distinguished by its rounded hairy leaves, and var. *rosea* by its pale pink flowers. Elsewhere in the Bulletin Mrs. J. Norman Henry mentions another pink variety and one with "café au lait"-colored blossoms, which she has discovered and introduced to gardens.

The Morris Arboretum is fortunate in possessing some unusually fine specimens of this highly ornamental genus. A fine tree of Mountain Silverbell (*H. monticola*, probably var. *vestita*) has attained a height of 32' 10", a spread of 42 feet and a trunk diameter of 18". Its branches sweep the ground, the flowers are large, of purest white, and, in full blossom on May 1 this year, it was a magnificent sight. A specimen of *H. diptera*, to the north of the Japanese Garden, is probably one of the biggest to be seen anywhere in cultivation. This, perhaps unusually, is of decided tree habit. It is now 42' 7" high, with a spread of 31 feet and trunk diameter of 2' 4". A second plant of the Mountain Silverbell, bushy in habit since the freeze of 1934, is about 23 feet high and 25 feet across. Among the smaller specimens is one of *H. carolina* of decidedly spreading form.

In the Philadelphia region these handsome plants do not, under normal conditions, seem to require any very special care. While tolerant of a fairly wide range of soils, they perhaps prefer one that is reasonably moist but at the same time well drained and not too shallow. At the Arboretum the finest specimens are to be seen in a sunny position on a sheltered southern slope, but this should not imply a need for coddling. Many excellent Silverbells are to be found flourishing in a hardier climate than our own—in Boston, Massachusetts; in Rochester, New York; in Cleveland, Ohio, and farther north yet. In these regions a sheltered position is more necessary than with us.

As still to be classified among the less common ornamentals, the Halesias or Silverbells are well worthy of the attention of anyone who is interested in first-class decorative plants.

Henry T. Skinner

LECTURE TOURS AT THE ARBORETUM

THE ATTENTION of horticulturists in the Philadelphia region is drawn to the following lecture or "discussion" tours which have been planned for times when a wide variety of plants are in interesting stages of growth at the Morris Arboretum and when illustrative material for each type can be found in greatest abundance:

June 21, 1941.

PESTS AND DISEASES OF WOODY PLANTS

Leader: E. PORTER FELT, Director of the Bartlett Tree Research Laboratories, Stamford, Connecticut.

Dr. Felt gained public recognition as an authority on insect pests when occupying the responsible position of State Entomologist of the State of New York. Over a period of several years his many books and writings on this topic have made his name a national byword in the field of pest control.

October 11, 1941.

TREE AND SHRUB MAINTENANCE

Leader: HARLAN H. YORK, Professor of Botany, Department of Botany, University of Pennsylvania.

Dr. York's name is familiar to readers of the Arboretum Bulletin and in scientific literature in connection with his researches in the field of disease control and related subjects of tree fertilization, pruning, etc. The latter topics will be illustrated and particularly stressed.

This series has been designed chiefly for amateur gardeners, but everyone is welcome and is cordially invited to attend. There is no charge. Visitors are encouraged to bring along their problems.

All tours commence at 2:30 P.M. on Saturdays at the Administration Building and will last for about two hours. In case of wet weather individual meetings will automatically be postponed one week. In this likelihood, confirmation can be secured by telephoning Chestnut Hill 5232. The first two tours of this series on May 17 and June 7, devoted to landscape topics and led, respectively, by Henry T. Skinner, curator of the Arboretum, and Professor R. W. Curtis of Cornell University, brought together a good and keen group of horticulturists.

TREE PRUNING TOOLS

THIS PAPER, the second of a series in the Bulletin, embodies brief descriptions of the more important tools which should be employed in tree pruning.

SHEARS.—The equipment should include hand and pole shears. Hand shears should be used only on very small twigs and branches not more than $\frac{1}{4}$ inch in diameter; pole shears (fig. 12, 13) should be employed only where it is not feasible for the worker to reach otherwise the parts to be removed. Although cuts made by shears may appear to be smooth, these tools usually leave numerous small cracks in the wood and bruise, and sometimes tear, the bark. When such injuries are moist, the entrance of parasitic organisms is greatly favored. Lopping shears should never be used for the final cut.

Ax.—Cuts made with an ax frequently result in permanent injury to the tender tissues. The effects of hacking or chopping of branches from young white pines are seen in Figures 20, 21. These cuts were made in early July while the cambium was actively growing. The blow of the ax bruised and tore this delicate tissue. Naturally, there followed a dying of the cells in and adjacent to the cambium, leaving wounds which became infected by various fungi.

These effects were more pronounced in the case shown in Figure 20. The latter also became infested with a pitch midge, which lives in the resinous exudations of pine. Through its feeding upon the inner living tissues of the bark, it stimulates a copious flow of resin; and the wounds it made, though slight, became infected with fungi, which killed the bark and thus increased the possibilities of the entrance of wood-destroying organisms.

Saws.—There are quite a number of types of saws designed primarily for tree pruning. Those illustrated and discussed are among the more commonly used; other designs may be especially adapted for certain types of cuts. The exigencies of the particular case at hand should determine the kind of saw to be used in removing a branch. For small branches, a small sharp saw with a straight or curved narrow tapering blade and a pistol-grip handle will often be most useful (figs. 8, 9, 10). Such saws, principally the one which has a narrow pointed blade (fig. 8), are especially handy in removing branches which may be closely placed on the tree (fig. 16). The type with a 16-18 inch blade (fig. 14) may have certain advantages, but should be limited to small branches. For branches 1-3 inches, or slightly more, in diameter, a narrow pointed saw with a blade about 18-20 inches long

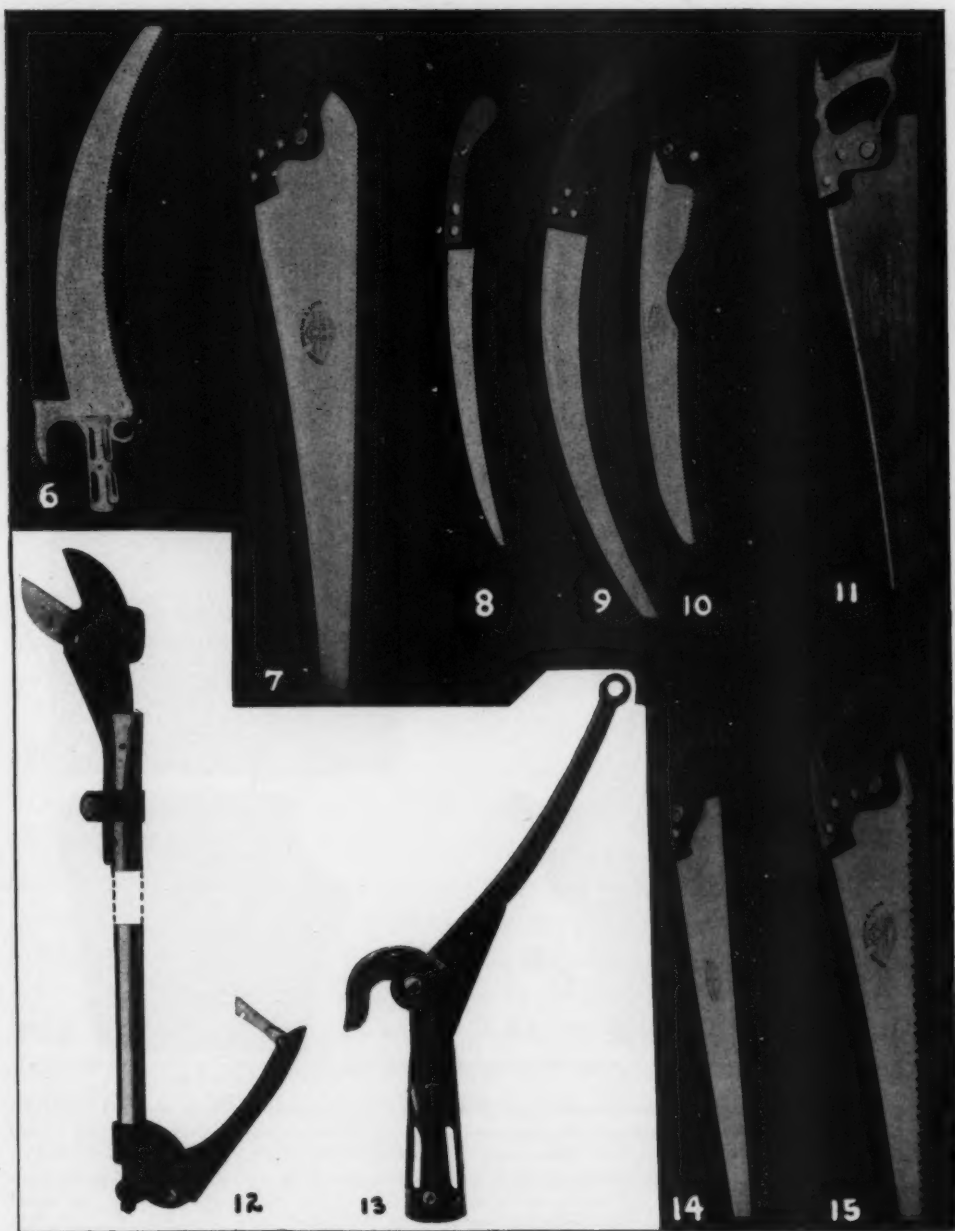


FIG. 6. A good type of pole saw.—FIG. 7. An excellent design for removing large branches.—FIG. 8. An excellent type of saw suitable for removing small branches.—FIG. 9. Same design as Fig. 8, only larger.—FIG. 10. Curved saw with a folding handle, which is desirable; the teeth in this type of saw are too large for most purposes.—FIG. 11. A "York State" pruning saw.—FIG. 12. The business ends of a 6-ft. aluminum handle pole pruner, well adapted for twigs and small branches.—FIG. 13. A good type of pole shears.—FIG. 14. A type of saw for removing branches less than $\frac{1}{2}$ " in diameter.—FIG. 15. A type of saw for heavy cutting.—(The tools shown in Figs. 6 and 13 were kindly lent by the F. A. Bartlett Tree Expert Company; those illustrated in Figs. 2, 7, 8, 9, 10, 11 and 14 by Henry Disston & Sons.)

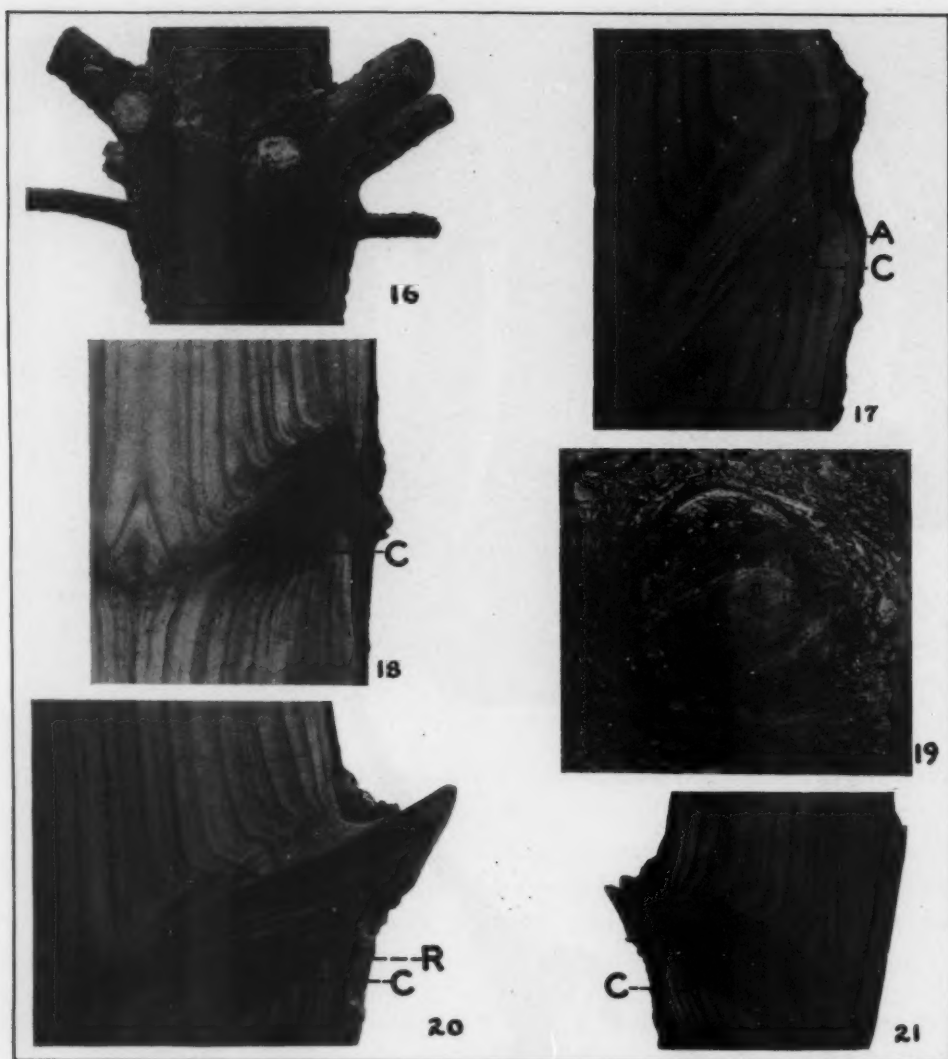


FIG. 16. A portion of the trunk of a young planted Scotch pine. There are 11 branches at this node. Note the crowded condition. The two smaller branches were dead.—FIG. 17. A view midway through a pruning wound on a young Scotch pine two years after the cut was made. Note the rough surface of the stub of the branch. This cut was made in December, 1937, when the cambium was dormant; section cut in late August, 1939. The dark area at C is due to an injury to the cambium being infected with fungi. A. The callus.—FIG. 18. A cut midway through a pruning wound on a planted white pine, taken 4 years after the branch was removed. The cut was made by a careless workman while the cambium was actively dividing. The stub, which was too long, was cracked. The injury at C was in the zone of the cambium. The dark color left of C is due to infection by wood-destroying fungi.—FIG. 19. A rough cut made with a saw (Fig. 14). The branch was about 2 inches in diameter. The cut should have been made with a saw like the one shown in Fig. 11 or possibly Fig 7. The heart wood has begun to crack open. The cut was made the middle of December, 1939, and photographed March 20, 1940.—FIG. 20. A similar cut made at the same time as the one in Fig. 21. C. Region of the cambium at the time of pruning. The heavy dark color at the left of this injury adjacent to the base of the twig indicates incipient decay. R. Heavy resinous exudate due to pitch midges.—FIG. 21. Radial cut through the node of a planted white pine tree pruned with an ax 4 years previously while the cambium was actively dividing (early

(fig. 11) can be used. It is known as the "York State Pruner" and is more of a general utility saw. For branches of greater diameter, larger and heavier saws will be necessary: the one shown in Figure 7 is widely used by experienced tree men, while the one seen in Figure 15 is designed for even heavier work.

Where it is not feasible to reach twigs and small branches near the outer extremities of the crown, it is often necessary to use a pole saw. The design shown in Figure 6 has all of the teeth pointing backward, and is used by many experienced tree men.

For most purposes, the number of teeth in a pruning saw should be not less than 7 per inch; on very large branches a saw with 6 teeth per inch, or one of the design seen in Figure 15, may be permissible. The coarser the saw, *i.e.*, the larger and fewer the teeth per inch, the rougher and more irregular the surface of the cut, thereby increasing the hazards from wood-destroying organisms. Saws with at least 8 teeth per inch are preferable for removing smaller branches. They are slower in operation, but they make smoother cuts. For conifers, *e.g.*, pines and spruces, fine-toothed saws may often become coated with resin; this should be removed with gasoline or kerosene.

It is important that saws be used by skillful operators. Figure 17 shows a branch 1 inch in diameter removed by an unskilled workman, though using a proper saw, similar to the one shown in Figure 11, with 7 teeth per inch. The cut was made two years prior to the preparation of the section. The nature of this cut and the injury to the cambium was such as to favor the entrance of fungi; in fact, they already had infected the darkened region at the lower margin of the cut. The results of using the wrong type of saw are shown in Figure 19. The branch was nearly 2 inches in diameter. A saw similar to the one shown in Figure 9 was used. The cut should have been made with a saw like the one illustrated in Figure 11, or possibly Figure 7. A rough unsightly cut was made unnecessarily. The rougher the cut, the more labor is required in treating the wound. From the cut shown in Figure 18, a branch nearly 1 inch in diameter was removed from a white pine with a saw similar to the one shown in Figure 7. The stub, protruding more than $\frac{1}{2}$ inch beyond the trunk, was cracked and the cambium severely injured. The darkened area to the left of C was infected with fungi. A saw of the design shown in Figure 11 should have been used.

July). C. The region of the cambium at the time of pruning. The heavy dark color at the left of this injury and adjacent to the base of the branch indicates incipient decay due to fungi.—(Figs. 16, 17 and 18 are used through the courtesy of the New York State Conservation Department and the Municipal Water Works of Rochester, New York.)

Climbing.—It is frequently necessary for workmen to climb trees. Expert climbers usually use ropes, but often it may be feasible to employ a ladder. If so, the lower ends should be provided with spikes, while the upper ends and the top rung should be bound amply with cloth to avoid injuring the tender tissues beneath the outer bark. Climbing by means of ropes during the period of cambium activity is open to question, especially where the bark is fairly thin. Workmen should wear soft rubber-soled shoes. The importance of avoiding injury to the cambium cannot be over-emphasized. A slight bruise, let alone a break in the bark, provides an avenue of entrance for wood-destroying fungi and insects. A warning against the use of spurs in climbing trees may not be out of place. Spur injuries may often be unsightly, and they invariably open up avenues in the bark for the entrance of wood-destroying organisms.

Sterilization.—One of the most obvious reasons for pruning is the removal of diseased and dead wood. Accordingly, the tools employed should be kept as sterile as possible. The fungous enemies of trees may often occur in the form of spores and hyphae on the outer surface of the bark and within the tissue of their hosts. Hence, these bodies often find lodgment upon the pruning hook and saws, particularly if the cut is made in diseased and dead wood. Thus, parts of fungi, as well as bacteria, may be transported easily—even long distances—and unwittingly transferred to the tissues of new and disease-free hosts.

One of the safest, best, and fairly inexpensive germicides for pruning tools is denatured alcohol, which may be carried in metal containers large enough to permit complete submergence of the tools.

Harlan H. York,

*Department of Botany,
University of Pennsylvania.*

COVER DESIGN

THE COVER design, representing a scene in the Japanese Garden, is a pen rendering made, together with the photograph of Figure 4, by Gustave Liebscher.

THE ORIGIN OF HORTICULTURAL FORMS IN CULTIVATED CONIFERS

EXHIBIT OF THE MORRIS ARBORETUM AT THE
PHILADELPHIA SPRING FLOWER SHOW

SEVERAL SPECIES of conifers have naturally, or in the course of a century or more of cultivation, when spontaneous variations are readily recognized, yielded a wide and diverse variety of horticultural forms. Some of these forms are so different in color, habit or type that it becomes hard to realize that they have actually been derived from one and the same parent species.

SPECIES, VARIETIES AND FORMS.—In horticultural usage the term "species" is applied to a naturally occurring group of plants which are similar in their important characters and which breed reasonably true from seed. Taking American Arborvitae, *Thuja occidentalis*, as an example, this is an Arborvitae of the genus *Thuja* and species *occidentalis*, a particular type native to this country and usually breeding true from seed. Yet, whether growing in the wild or under cultivation, certain individuals derived from these species will show variations in color, form or habit from the parent plant. If these variants breed true from seed they are normally classified as "varieties"; if they are seed variable and have to be vegetatively propagated by cuttings or grafts they are then given the lesser designation of "horticultural form" or "clon." The Globe Arborvitae, *Thuja occidentalis globosa*, is thus a horticultural form of American Arborvitae (*Thuja occidentalis*) and, conversely, *Thuja occidentalis* is the parent species from which the smaller globe form has been derived.

THE ORIGIN OF HORTICULTURAL VARIETIES.—Variations in plants of this type may be due to any of three causes:

(1) *Changes of environment.* Species growing under differing conditions of elevation, rainfall or soil may show quite marked changes in habit, color of foliage, etc. But since these changes are of the individual rather than of the race, they are probably never transmitted by seed, at least so far as is indicated by present experimental evidence.

"Geographical forms" have probably originated not as a direct result of change of environment, but rather represent the end products of long periods of natural selection—quite possibly well adapted to existence under the conditions of this particular environment, but the details of the relationship represent, in a sense, a purely chance evolution.

(2) *Those which are due to a recombination of hereditary traits as a result of cross pollination or hybridization.* The intercrossing of species and varieties is the most important general method of obtaining new and improved horticultural forms of cultivated plants. In conifers, however, this does not seem to have commonly occurred; the varieties are usually derived from a single species. But a notable exception is the Yew family and an example, *Taxus media Hatfieldi*, which is the product of a cross between the Japanese Yew, *Taxus cuspidata*, and the English Yew, *Taxus baccata*. Such plants of hybrid origin do not breed true from seed and hence must be propagated from cuttings or grafts.

It should be noted, however, that even within a single species cross pollination between individuals may still result in some recombination of minor hereditary traits, producing a few individuals which may differ slightly from their parents. Most of the varieties of Japanese and English Yew (both true species) are seedling variants of this kind and again are propagated vegetatively.

(3) *Those due to mutations.* A "mutation" is a modification of growth or habit resulting from a sudden change occurring within a single growing cell of a seed or bud. The new individual may thus appear from seed or as a distinctively modified shoot or "bud sport" borne upon the parent plant. If detached and propagated, such a bud mutation may then be cultivated as a new horticultural variety. In such a manner many dwarf or distinct forms of conifers, such as the Dwarf Alberta Spruce, have arisen by the propagation of seedling mutations or, like the very low Maxwell Spruce, from those curious clustered bud sports or "witch's brooms" which quite frequently appear upon single branches of otherwise normal trees.

Seed or bud mutations occur relatively commonly among conifers and probably represent the chief mode of origin of many new variants. In a true mutation the genetic complex is affected and hence the new individual can be safely propagated by either seed or vegetative methods.

The above discussion formed the theme of the Arboretum Exhibit which received an Award of Merit at the Philadelphia Spring Flower Show. Nine species of Retinospora, Juniper, Spruce, Yew and Arborvitae were chosen as representative of the parent types of a selection of varieties and horticultural forms grouped in conjunction with them. The identity and relationship of these varieties to the parent types was indicated by means of explanatory labels and connecting colored strings. The plants were arranged in a pleasing landscape setting and evoked considerable interest on the part of Flower Show visitors.

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